An LF Band Transceiver

SELF-CONTAINED UNIT FOR 160, 80, 40 METRES

D. NOBLE (G3MAW) & D. PRATT (G3KEP)

Essentially, this is a design for a transportable three-band station, suitable for either mains or battery power supply. As such, it is low-powered and is intended to give QSO's rather than to work DX. Various forms of construction are possible round the circuitry given, which embodies transceiver principles in that the audio section is used both for transmission and reception.—Editor.

THE need arose for a small self-contained transmitter - receiver which could be employed for mobile, portable or fixed station use. It was required to operate on the LF bands, either with CW or good quality telephony. A circuit was evolved to meet these conditions, and the diagram of the final unit is shown in Fig. 1. Originally, the transmitter was crystal controlled only; but, due to many unsuccessful attempts to break into local nets, it was decided to provide for VFO operation on 160 metres. It should, however, be mentioned here that operation on any other band still does necessitate the use of crystal control.

The main reason for constructing such a transceiver was that of working while on holiday, when the need is for taking a minimum of equipment. This transmitter-receiver has also proved to be of great value in quickening the interest of several short-wave listeners by using it to operate /A from their homes prior to them receiving their own licences.

The general arrangement consists of a 1-V-2 TRF receiver using a Brimar 6BX6 in the RF and detector stages, with a 6AM6 and 6BQ5 as audio valves. The transmitter runs a 6C4 Clapp VFO on 160 metres, into a 6BX6 buffer and 6BQ5 PA employing pi-section coupling to the aerial, with Heising (choke control) modulation of the PA by using the two receiver AF stages and a crystal microphone. The unit was built on a chassis 6 x 9 x 2½ inches with a front panel 6 x 9 inches. Two power supplies were constructed; one is for AC mains operation, the other being a vibrator unit for 6 volt DC operation. Each unit was built on a chassis 3 x 9 x 2½ inches, and the plug arrangement adopted permits either power supply to be fitted directly on to the main chassis, making the total table space for the chassis nine inches square. The output from each power supply is 250 volts at 80 mA.

Transmitter

As explained earlier, the VFO was an afterthought, and this had, therefore, to be mounted on a small sub-chassis to the rear of the receiver section. The circuit values were determined by experiment, and are given in the table. Output is taken from the VFO by means of a short length of co-axial cable fitted with a wander-plug so that it can be coupled into the crystal socket when 160-metre VFO operation is required. The second valve in the transmitter operates as a conventional untuned buffer amplifier when VFO is used, and as a Pierce oscillator when a crystal is inserted. The coil of the pi-network circuit was fitted with a three-way rotary switch so that operation on the three LF bands could be obtained.

Receiver

As the equipment was to be used for local telephony and EU/CW working, it was decided that a TRF design should serve the purpose quite adequately. Denco B9A permeability-

Table of Values

Fig. 1. Transmitter, Receiver and Modulator sections of the Transceiver

C1, C21, C27	3-30 μμF Philips Trimmer	C35, C38	25 μF 25v. wkg. electrolytic
C2	50 μμF variable	C36	.05 μF paper
C3	120 μμF silver mica	C37	.005 μF paper
C4, C5	.001 μF silver mica	R1, R2	100,000 ohms
C6, C7, C10, C13, C28, C29	100 μμF silver mica	R3, R6, R9	180 ohms
C8, C39	0.1 μF paper	R4, R8	10,000 ohms
C9, C11, C12, C15, C16	.001 μF disc ceramic	R5	18,000 ohms
C14, C23, C24, C25, C31, C32	.01 μF paper	R7, R15, R19	22,000 ohms
C17	.002 μF silver mica, 1000v. wkg.	R10, R13	33,000 ohms
C18	.0005 μF variable	R11	470 ohms
C19	.0005 μF 2-gang variable	R12, R18	1 megohm
C20, C26	150 μμF silver mica (for 160 metres)	R14	47,000 ohms
C22	50 μμF 2-gang variable	R16	4.7 megohms
C30, C34	8 μF 350v. wkg. electrolytic	R17	4,700 ohms
C33	470 μμF ceramic	R20	2.2 megohms
		R21	220,000 ohms
		R22	130 ohms
		VR1	100,000 ohms potentiometer
		VR2	500,000 ohms potentiometer
		Ch	10 Henry 40 mA LF Choke
		M	0-50 mA meter
		V1	Brimar 6C4
		V2, V4, V5	Brimar 6BX6
		V3, V7	Brimar 6BQ5
		V6	Brimar 6AM6

L1 — 90 turns, 30g enamelled copper wire, close wound on ⅝ in. diam. paxolin former.

L2 — 60 turns, 22g. enamelled copper wire, close wound on 1⅝ in. diam. paxolin former, tapped at 30 and 40 turns from aerial end.

L3 — Denco B9A plug-in coil "Blue" Range 3 for 160 and 80 metres, Range 4 for 40 metres.

L4 — Denco B9A plug-in coil "Green" Range 3 for 160 and 80 metres, Range 4 for 40 metres.

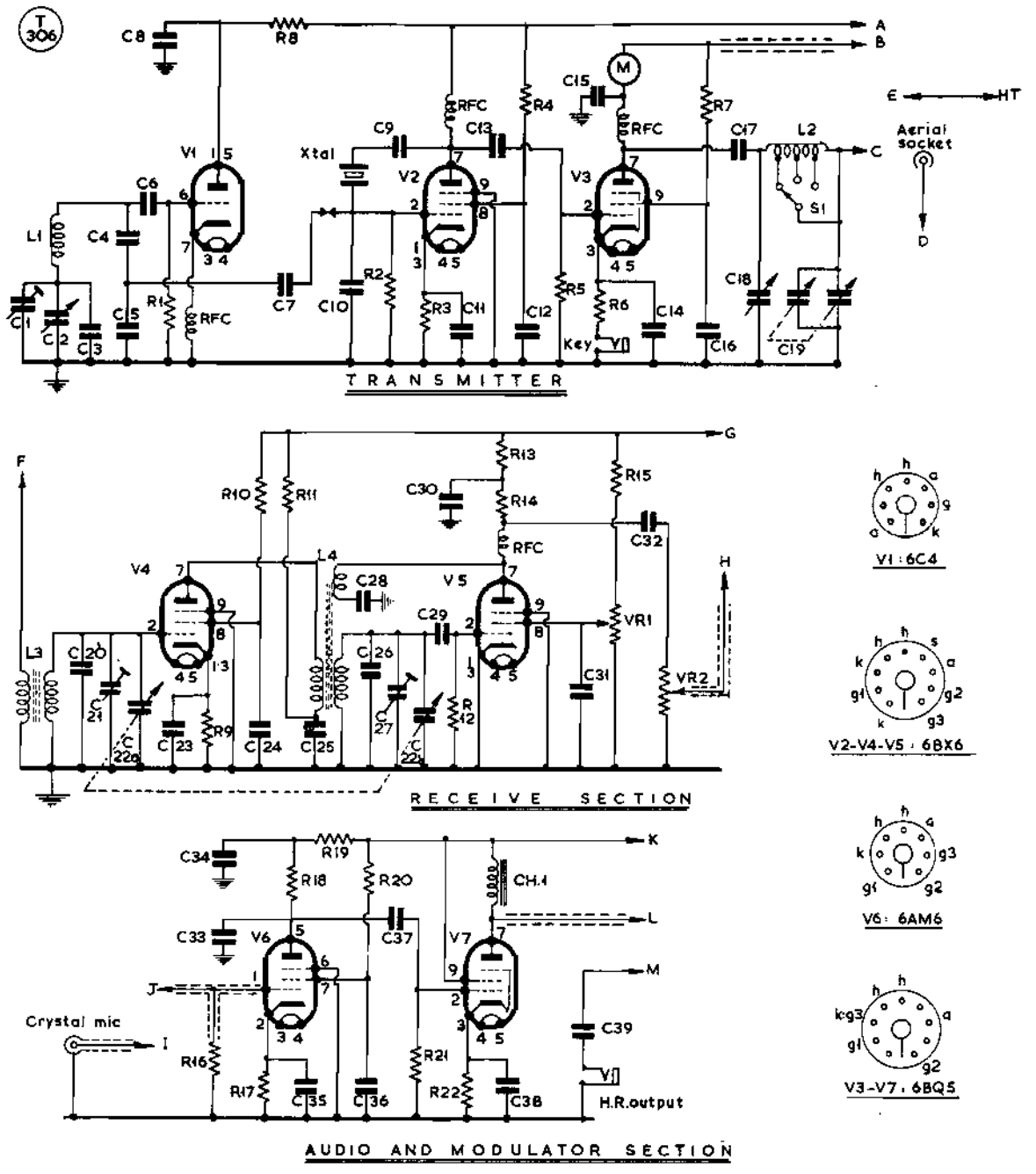


Fig. 1. Circuit arrangement for the transmitter, receiver and modulator for the transceiver described by G3KEP/G3MAW. On "transmit," the audio side of the receiver functions as the modulator. Either VFO or CO drive can be used.

tuned plug-in coils are employed, and, so as not to necessitate the need for a high-capacity variable condenser for band-setting (which would have required a larger chassis) fixed padding condensers were soldered across the actual coil pins. There is the disadvantage, however, that separate coils are required for each band. The tuning condenser used is a

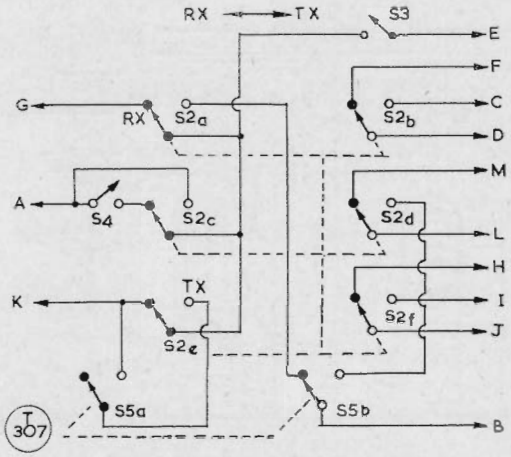


Fig. 2. Switching for the Transceiver. S2 is the send-receive switch, shown in the "receive" position, and S5 is the CW/phone switch, set for "CW." Toggle switches S3 and S4 are for main HT on-off and VFO netting respectively.

miniature 2-gang 50 $\mu\mu$F type, and Philips concentric trimmers were placed across the tuning condenser for final adjustment. The detector is fed *via* the AF gain control and transmit-receive switch to the AF stages. Output is taken from the anode of the 6BQ5 through a 0.1 μF condenser to a jack socket mounted on the front panel. In the prototype, a 5-inch loudspeaker and output transformer were built into a Denco speaker cabinet. High-impedance phones can be used but, due to the large amount of audio power available, these cannot be recommended! The AF gain control operates only on the receiver; on "transmit," the circuit values are worked out to given full modulation with a crystal microphone.

Table of Values

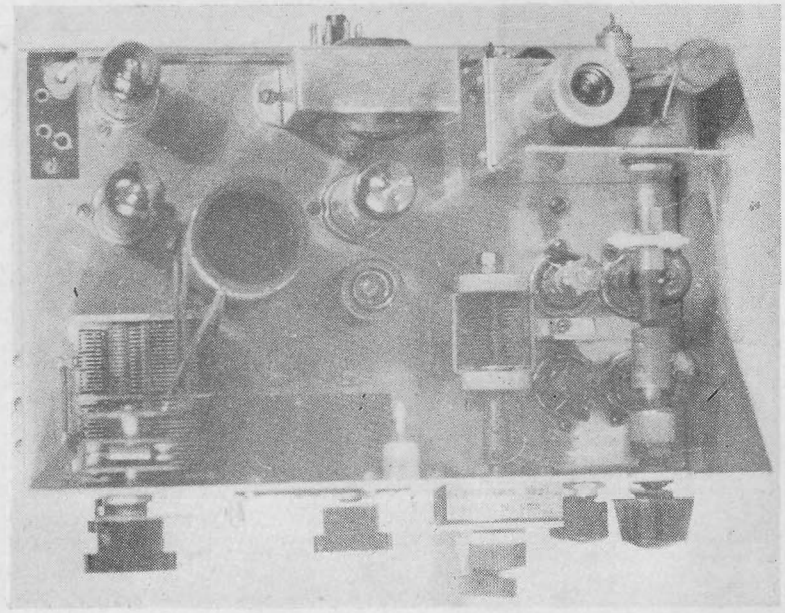
Fig. 3. Vibrator Power Supply

C1, C2	= .05 μF paper	R1, R2	= 47 ohms
C3, C4	= 100 μF 25v. wkg. electrolytic	RFC	= 2.5 mH RF choke
		CH1,	
C5	= .01 μF 1000v. wkg. paper	CH2	= *see text*
		CH3	= 10 Henry, 80 mA choke
C6	= 0.1 μF paper		
C7, C8	= 16 μF 500v. wkg. electrolytic	T1	= Vibrator transformer (*see text*)

Switching

The change-over switch S2 employed was a 2-bank wafer assembly selected from the junk-box. Either one of this type or a P.O. key switch may be used for S2, but whichever is the case, it is essential to keep the AF switching contacts away from those which change over the aerial, or feedback will result. A double-pole change-over toggle is used to select phone or CW. A toggle-switch to enable the VFO, or CO, to be brought on during reception is included, as is also a switch in the HT feed to the whole unit.

The 6-volt vibrator power supply circuit diagram is shown in Fig. 3. The transformer used in the model was a mains type having a 250-0-250 volt winding and two 4-volt windings; the two LT windings were connected in series, with the mains input winding unused. Any suitable mains transformer would serve, although better results would be obtained from a vibrator transformer wound for the purpose. Nevertheless, the set-up shown met the purpose quite adequately, and an output of 250 volts at 80 mA was obtained for an input of 6 volts. The vibrator used is a Wearite 6-volt synchronous type QFA/6, obtainable on the "surplus" market. In the battery leads are two filter-chokes, Ch1 and Ch2. These can be wound with about two yards of 14g. enamelled copper wire on pieces of $\frac{1}{2}$in. wooden dowel.



Plan view of the G3KEP/G3MAW Transceiver layout, with the receiver section on the right; the VFO is mounted on the sub-chassis, behind the receiver, the output being fed through coax to the grid-pin of the crystal socket, at top left. At centre are the modulator and receiver output stages. Brimar miniature valve types are used throughout, the PA being a 6BQ5.

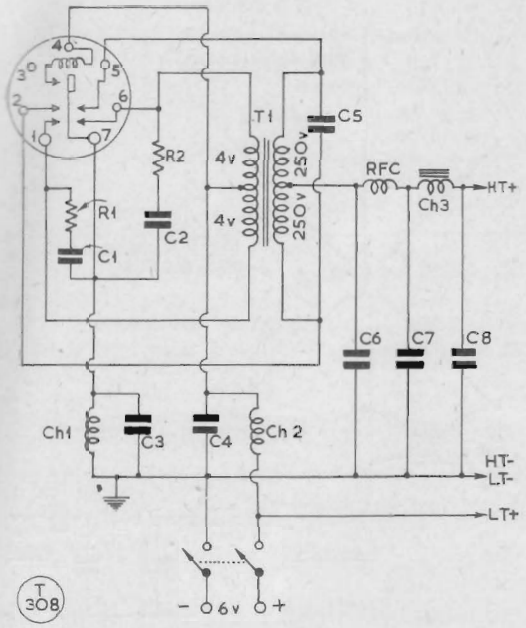


Fig. 3. Vibrator power supply unit for the Transceiver. If used for portable or mobile work (in a car) a separate battery should be provided, as most car electrical systems are positive-earthed.

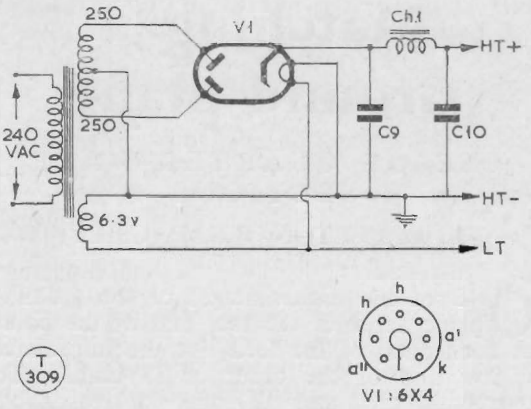


Fig. 4. A standard type of mains HT supply unit for operating the Transceiver.

Table of Values

Fig. 4. AC Power Supply Unit

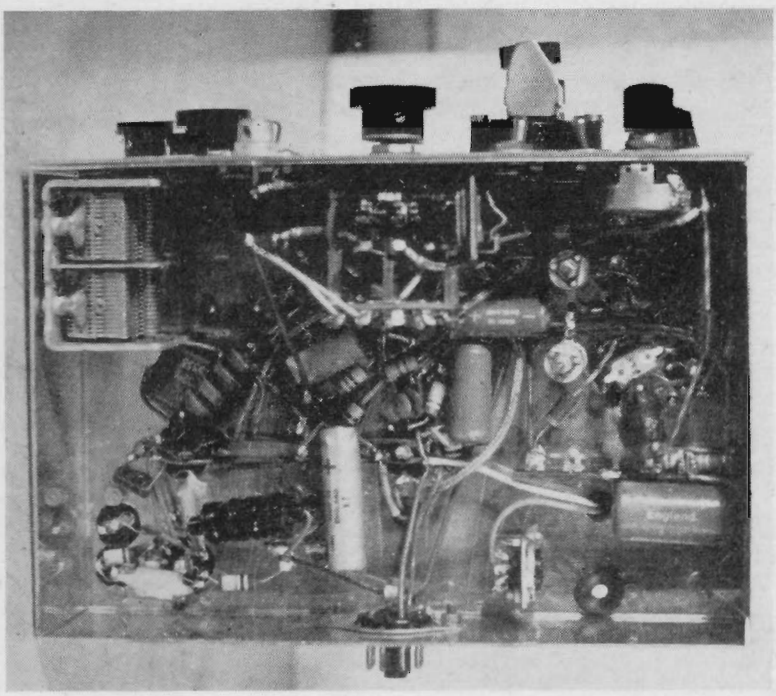
C9, C10	= 16 μF, 500v. wkg. electrolytic	T1	= 250-0-250 volts at 80 mA, mains xformer
CH1	= 10 Henry, 80 mA choke	V1	= Brimar 6X4

The wiring on the LT side should be kept as short as possible, using thick, low-resistance wire, or a reduction in output will ensue.

For the mains power-supply, a transformer capable of delivering 250 volts at 80 mA is required. In the prototype, a transformer with one heater winding only was available, so that a rectifier valve with an isolated cathode had to be used.

Results

The unit described here is operated on 160 metres with a long-wire aerial; results compare quite favourably with the writers' own Top Band transmitters, and several European contacts have been made. On 80 and 40 metres, good phone and CW reports are consistently received from all over the British Isles, while several QSO's have been obtained with Russian stations. On phone, the input is 6 watts, while on CW it may be increased to 8 watts.



General arrangement of the Transceiver below chassis, with the transmitter section on the left. Components and circuitry are economised by making the audio section common to both transmitter and receiver. The B7G valveholder mounted vertically near the power plug was used for a voltage stabiliser, which proved unnecessary in the final design.